Report on the Third Operational Phase Air Media Sampling Program – Winter 2008

Final Report

AECOM

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Executive Summary

The Montgomery County, Maryland Solid Waste Resource Recovery Facility (RRF), near Dickerson, Maryland became operational in the spring of 1995. During the planning process for this facility, citizens in the area expressed concerns regarding the potential human health effects associated with exposure to emissions from this facility. In response to this concern, the County initiated a multi-media monitoring program in the vicinity of the facility to monitor the concentrations of various organic (e.g., dioxins/furans) and inorganic (e.g., metals) constituents in abiotic and biotic environmental media. The sampling program includes air-monitoring and non-air media monitoring components. This report describes the results of the winter 2008 air sampling program and discusses the results in comparison to results obtained in the 1994-95 (pre-operational phase program), 1996-97 (first operational phase) and 2002-03 (second operational phase) programs.

The third operational phase monitoring occurred during January 10, 2008 through February 16, 2008, approximately 12 years after the RRF became operational. The air samples collected during the program were analyzed for polychlorinated dioxins and furans (PCDDs/PCDFs) and selected metals (arsenic, beryllium, cadmium, chromium, lead, mercury, and nickel). These data were evaluated to determine whether evidence exists that facility operations made a detectable difference in the levels of any of these chemicals in the vicinity of the RRF.

Two sites for air sample collection were selected based upon air dispersion modeling conducted in support of the health risk assessment update for the RRF and recommendations of the Dickerson Area Facilities Implementation Group (DAFIG) Air Quality Committee based on their review of past programs. The air dispersion modeling, based on as-built parameters, provides an estimate of the magnitude and spatial distribution of air concentrations resulting from RRF stack emissions. Stationary monitoring sites were erected in Beallsville, MD (approximately 4.5 kilometers to the southeast of the RRF) in an area of peak modeled ground-level air concentrations ("impact" site), and in Lucketts, VA (approximately 6.8 kilometers to the northwest of the RRF) where facility impacts were predicted to be insignificant ("background" site). The air sampling locations are shown on an area map that also illustrates the modeled air concentrations in the form of isopleths in Figure ES-1. Air samples were collected at the Lucketts site to provide representative "background" data for the area, while the Beallsville site is a representative "impact" site where air concentrations could reflect a contribution from RRF air emissions based on dispersion modeling and wind patterns.

The program results indicate that the air contains background levels of the target metals and PCDDs/PCDFs. The PCDDs/PCDFs detected are typical of numerous combustion sources, including coal-fired electric power generation, home wood burning and vehicle emissions. Given uncertainties associated with non-detected congeners, PCDDs/PCDFs toxic equivalents (TEQs; see section 4.2.1) were calculated two ways to show the range of TEQs that could result depending on the treatment of detection limits: 1) assuming zero values for all non-detects and 2) assuming non-detects are present at a concentration equal to the detection limit. Based on the assumption that non-detects are present at detection limit concentrations, the levels of PCDDs/PCDFs indicate a potentially decreasing trend over time (see Figure ES-2). As shown in figure ES-2, TEQ values from the third operational phase (2008) and second operational phase data (2002-2003) appear to be much lower than the preoperational phase (1994) and first operational phase (1995-1996). This is primarily due to the improvement of detection limits for the second and third operational phases compared to the preoperational and first operational phases. The second and third operational phase data, which have improved detection limits, indicate ambient levels are not increasing, and possibly decreasing.

For the case where non-detects are assumed to be zero (Figure ES-3), the TEQ data are relatively comparable for all phases with the exception of the first operational phase data which appear to be the lowest measured data for both the Beallsville and Lucketts sites. The highest TEQ data for Beallsville were measured during the second operational winter phase and the highest data for Lucketts were measured during the second operational spring phase. However, TEQs measured during the third operational winter phase for both Beallsville and Lucketts are lower than these highest values.   It is difficult to draw conclusions from comparison of the second and third operational data to the first operational and pre-operational data where many congeners were not detected, but there does not appear to be any trend, increasing or decreasing.

These results are consistent with the predictions of the air dispersion and deposition modeling conducted by AECOM (formerly ENSR) using as-built stack engineering parameters and measured stack emission rates for individual chemicals. Because the facility is equipped with state-of-the-art air pollution control equipment, air emissions from the facility stack are very low and therefore, the modeling results indicate that incremental changes in the air media for most chemicals are several orders of magnitude below the background levels. Any changes in concentration of these metals or dioxins/furans from the RRF at the levels predicted by the modeling would be within the normal variability of the sampling and analysis methods available, and therefore not detectable.

While there are no indications in the data sets collected for the pre-operational and operational phase programs that the RRF is impacting ambient air quality, as the facility ages, periodic monitoring (once every five years) for selected parameters would provide continued assurance, as well as building a sound database for long-term use. This database would ensure that future changes in operation of the RRF or other emission sources in the area could be adequately evaluated for their impact on air quality.

Conclusions and recommendations are summarized below in Table ES-1.

Table ES - 1:   Conclusions and Recommendations

Chemicals	Observations/Conclusions	Recommendations
Polychlorinated Dioxins and Furans (PCDDs/PCDFs)	All congeners were detected with 30 day sampling. Assuming non-detects present at detection limits, third operational phase (2008) and second operational phase (2002-03) TEQs appear to be much lower than the first operational (1996-97) and preoperational (1994) phases. The latter is primarily due to the improvement of detection limits for the second and third operational phases compared to previous phases. The second and third operational phase data, which have improved detection limits, indicate ambient levels are not increasing, and possibly decreasing. Assuming non-detects are zero, TEQ data are relatively comparable for all phases with the exception of the first operational phase data which appear to be the lowest measured data for both the Beallsville and Lucketts sites. The highest TEQ data for Beallsville were measured during the second operational winter phase and the highest data for Lucketts were measured during the second operational spring phase. However, TEQs measured during the third operational winter phase for both Beallsville and Lucketts are lower than these highest values. It is difficult to draw conclusions from comparison of the second and third operational data to the first operational and pre-operational data where many congeners were not detected, but there does not appear to be any trend, increasing or decreasing.	Continue periodic monitoring during one out of every five years and collect 30-day samples to develop database with improved detection limits.
Metals	Comparison of historical data show general variability with no discernable trends. Arsenic and Chromium concentrations measured at both Lucketts and Beallsville exceeded the EPA "RSL screening levels" (levels developed by U.S. EPA to conservatively screen for potential air contaminant exposure at Superfund sites) but are not unusual for other rural areas in the US. Also, lesser concentrations were observed downwind of the RRF at Beallsville than upwind at Lucketts, and overall observed ambient air concentrations are not inconsistent with the modeled ambient air concentrations attributable to the RRF contained in the County's Health Risk Assessment for the RRF.	Continue periodic monitoring during one out of every five years to establish database and independently confirm APC performance and conservative air dispersion modeling.

Figure ES - 1:   Modeled Air Concentrations and Monitor Locations
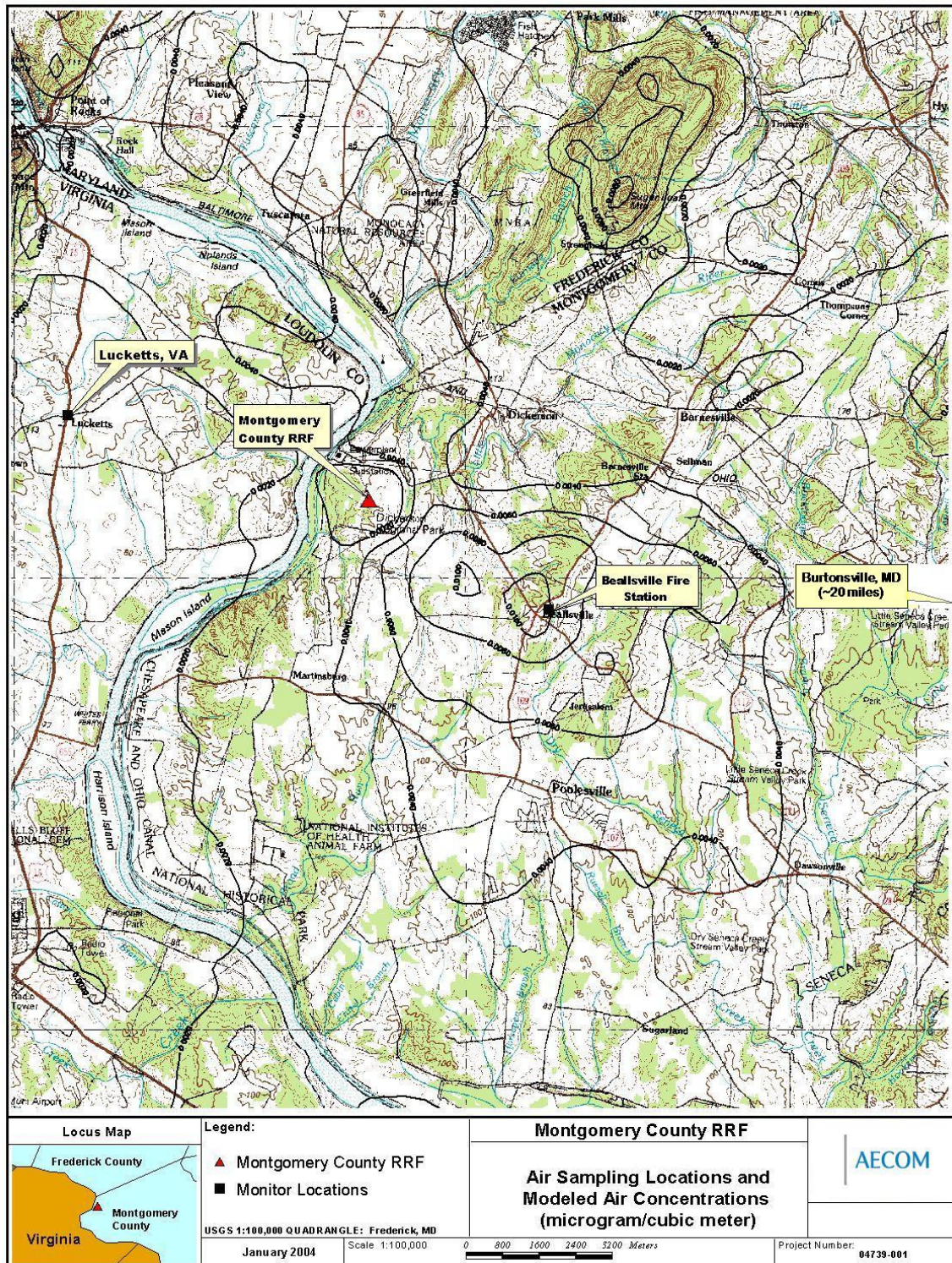
Figure ES - 2: PCDDs / PCDFs Data Comparison – Pre-Operational Phase and Operational Phase Programs – Non-detects at Detection Limit Concentrations
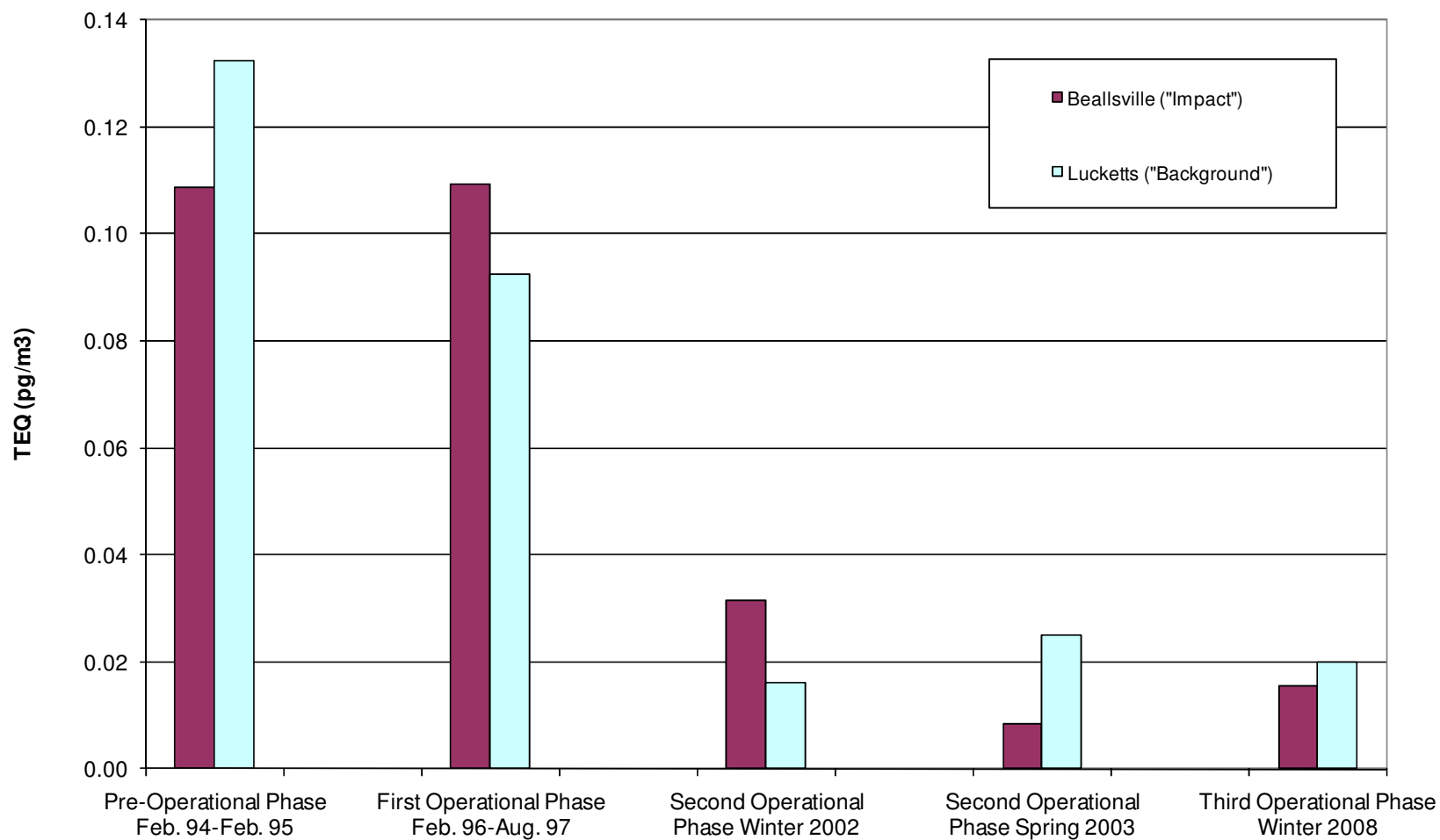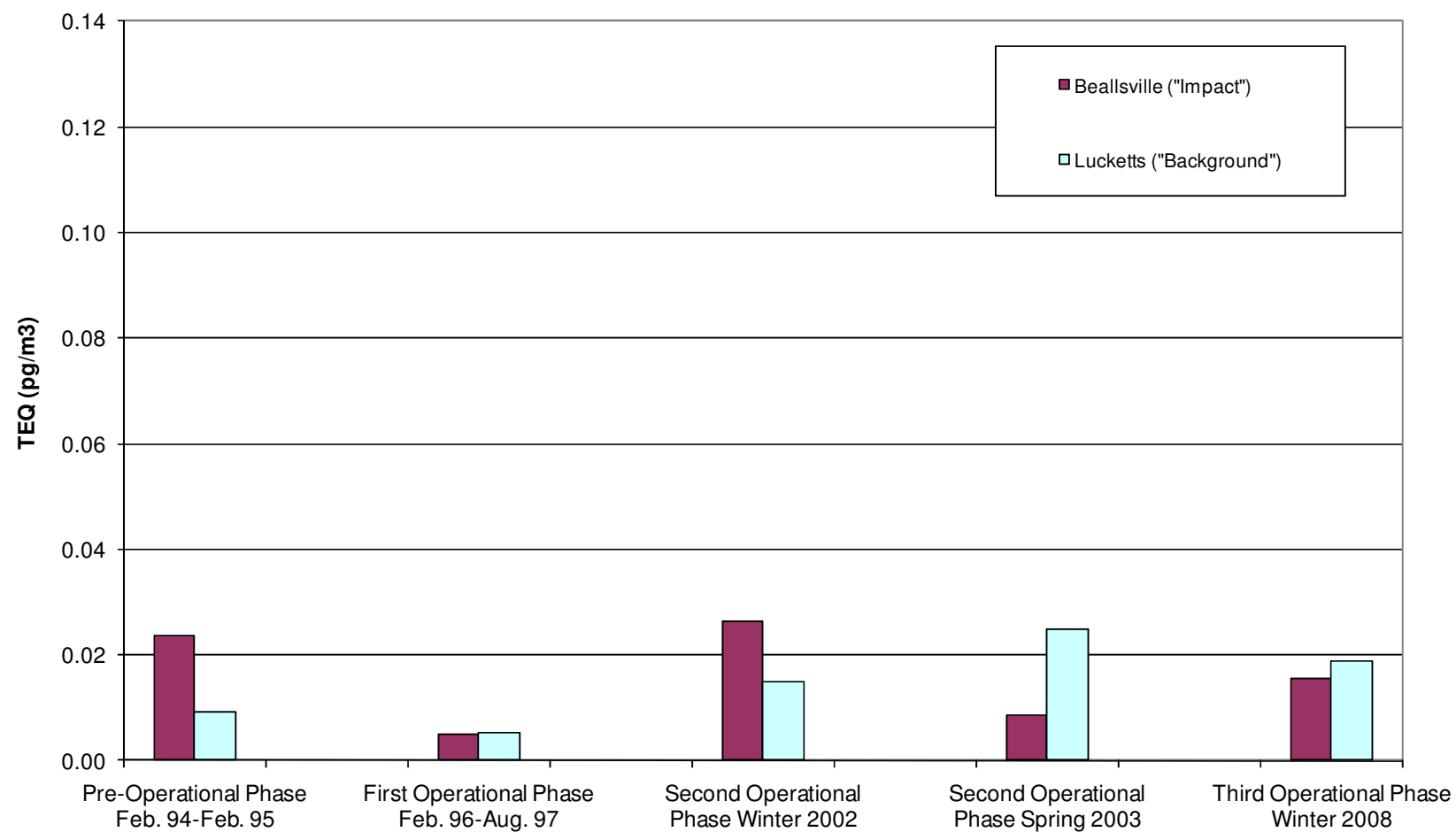
Figure ES - 3: PCDDs / PCDFs Data Comparison – Pre-operational Phase and Operational Phase Programs – Non-detects at Zero

1.0   Introduction

The Montgomery County, Maryland Solid Waste Resource Recovery Facility (RRF), near Dickerson, Maryland became operational in the spring of 1995. During the planning process for this facility, citizens in the area expressed concerns regarding the potential human health effects associated with exposure to emissions from this facility. In response to this concern, the County initiated a multi-media monitoring program in the vicinity of the facility to monitor the concentrations of various organic (e.g., dioxins/furans) and inorganic (e.g., metals) constituents in abiotic and biotic environmental media. The sampling program includes air-monitoring and non-air media monitoring components. This report describes the results of the winter 2008 air sampling program and discusses the results in comparison to results obtained in the 1994-95 (pre-operational phase program), 1996-97 (first operational phase) and 2002-03 (second operational phase) programs.

The air-media sampling program was designed to measure a selected set of organic chemicals and metals generally associated with particulate and gaseous emissions from the combustion of municipal solid waste. The objective of the air sampling program was to gather ambient air data for emission constituents which may directly affect human health. The pre-operational phase of the air monitoring was conducted between February 1994 and February 1995. The pre-operational program was designed to produce baseline data for target chemicals in ambient air. Subsequent to the facility becoming operational, air media monitoring was conducted beginning in February 1996 and concluding in August 1997. Following review of the pre-operational and first operational phase air sampling programs, the County's Dickerson Area Facilities Implementation Group (DAFIG) Air Quality Sub-committee recommended that the air program be conducted periodically (once in five years) and be limited to select toxic metals and dioxins/furans. The second operational phase monitoring effort in this program was conducted in two phases; a period of 29 days during December 10, 2002 - January 8, 2003 and the second phase, a 33-day period, May 21 through June 23, 2003.

This report summarizes the results of the third operational phase monitoring that occurred during January 10, 2008 through February 16, 2008, approximately 12 years after the RRF became operational. The air-media sampling program was designed to measure a selected set of organic chemicals and metals generally associated with particulate and gaseous emissions from the combustion of municipal solid waste. The objective of the air sampling program was to gather ambient air data for emission constituents which may directly affect human health.

Two sites for air sample collection were selected based upon air dispersion modeling conducted in support of the health risk assessment update for the RRF and recommendations of the DAFIG Air Quality Sub-committee based on their review of past programs. The air dispersion modeling, based on as-built parameters, provides an estimate of the magnitude and spatial distribution of air concentrations resulting from RRF stack emissions. Stationary monitoring sites were erected in Beallsville, MD (approximately 4.5 kilometers to the southeast of the RRF) in an area of peak modeled ground-level air concentrations ("impact" site), and in Lucketts, VA (approximately 6.8 kilometers to the northwest of the RRF) where facility impacts were predicted to be insignificant ("background" site). The air sampling locations are shown on an area map that also illustrates the modeled air concentrations in the form of isopleths in Figure 1-1. Air samples were collected at the Lucketts site to provide representative "background" data for the area, while the Beallsville site is a representative "impact" site where air concentrations could reflect a contribution from RRF air emissions based on dispersion modeling and wind patterns.

Windroses of the meteorological data collected from the 10-meter tower adjacent to the Yard Trim Composting Facility (YTCF) for the sampling period is provided in Figure 1-2. The windrose shows that winds were predominantly from the north-northwest through north sectors. Winds from the northwestern sectors [north-northwest (13.5% of the time), northwest (10% of the time), and west-northwest (9% of the time)] are

consistent with winds that place the Lucketts monitor upwind of the RRF, and the Beallsville monitor location downwind of the RRF (approximately 33.5% of the time).

Analyses of the air samples from the monitoring sites were conducted for those potential emissions of most concern for human health risk, including polychlorinated dioxins and furans (PCDDs/PCDFs), and selected toxic metals (arsenic, beryllium, cadmium, chromium, lead, mercury, and nickel).

Data from the winter 2008 program are compared with data collected from the pre-operational phase, first operational phase and second operational phase sampling programs to determine if there is any evidence that the operation of the RRF has a potential impact upon the ambient air quality in the area.

Figure 1-1: Air Sampling Locations and Modeled Air Concentrations
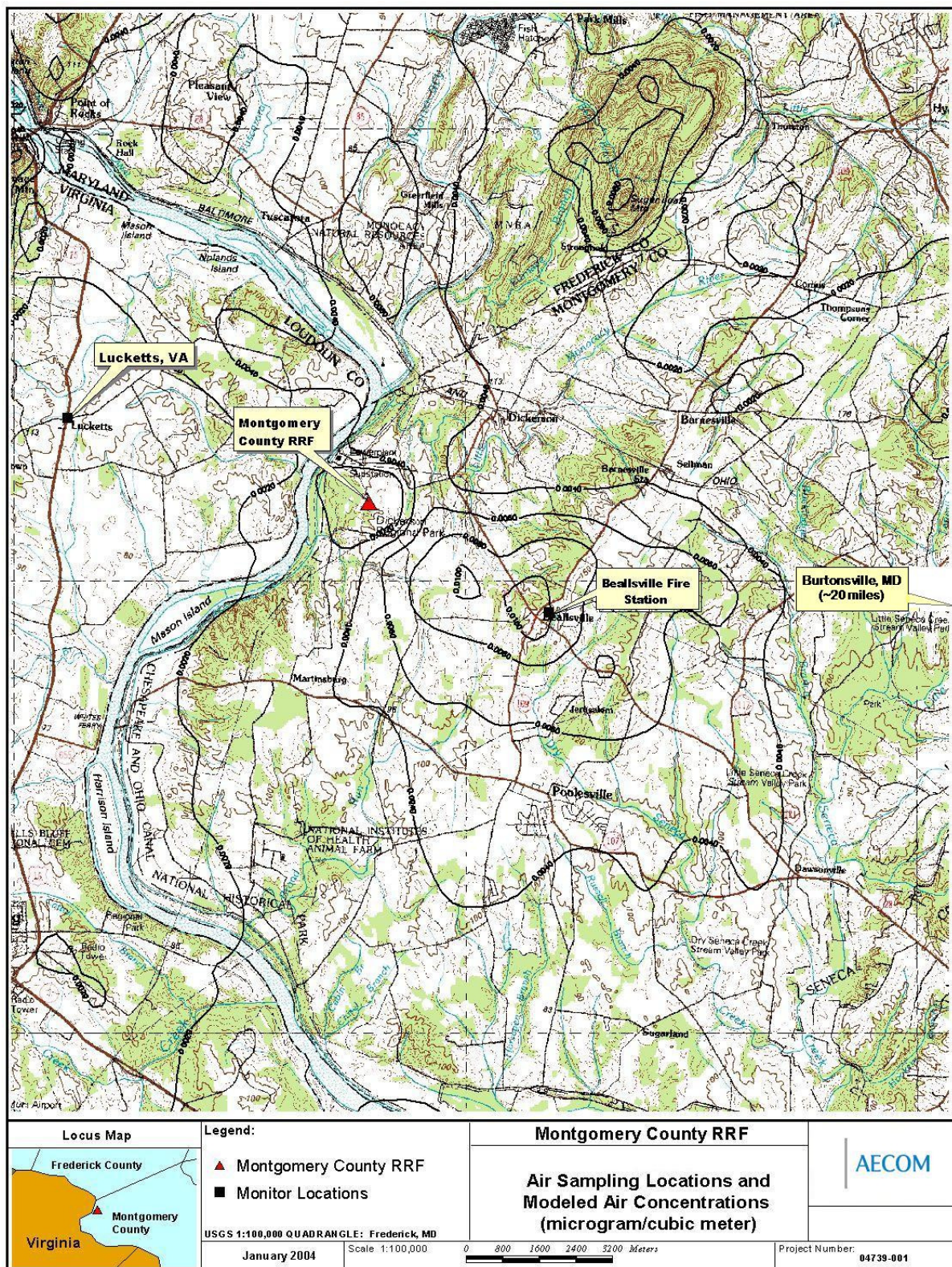
Figure 1-2: Windrose for Winter 2008 Sampling Period

WIND ROSE PLOT:

Wind Rose - Montgomery County RRF Meteorological Tower Data 2008

DISPLAY:
 **Wind Speed
Direction (blowing from)**

WIND SPEED
(m/s)

(cyan)	>= 11.1
(green)	8.8 - 11.1
(blue)	5.7 - 8.8
(red)	3.6 - 5.7
(yellow)	2.1 - 3.6
(magenta)	0.5 - 2.1

Calms: 0.33%

COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	**2008
Jan 1 - Feb 16
00:00 - 23:00**	**ENSR**	
		MODELER:
Adrienne Kieldsing	**ENSR | AECOM**
	CALM WINDS:
0.33%	TOTAL COUNT:
911 hrs.	
	AVG. WIND SPEED:
2.35 m/s	DATE:
7/9/2008	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

2.0   Sampling Program

The air sampling locations for the 2008 sampling event were consistent with the second operational phase sampling event in 2003. That is, monitoring stations were erected at the "impact" site in Beallsville, MD and in the background site in Lucketts, VA (refer to Figure 1-1). These sites were selected based upon air dispersion modeling conducted in support of the health risk assessment update for the RRF. Consistent with previous programs, a co-located sampler was utilized at the "impact" site in Beallsville. This is also consistent with U.S. EPA guidance (U.S. EPA 1998) where co-located samplers are recommended for the "impact" site.

The ambient sampling program was designed to address a set of chemicals reported in the literature for air emissions of municipal solid waste combustors that are of concern for human health. These chemicals include both organic chemicals and metals. The organics set consisted of polychlorinated dibenzodioxins and furans (PCDDs/PCDFs, commonly called dioxins), that may be formed or released during waste combustion. A total of seven (7) metals that are of primary concern for human health risk were also measured; namely, arsenic, beryllium, cadmium, chromium, lead, mercury and nickel. These metals may bio-accumulate in humans and are of concern for public health as carcinogens, or for their cumulative toxic effects.

All organic chemicals and metals monitored are widely distributed as trace levels in the environment as the result of natural combustion from human activities. Some metals may be naturally occurring and present in the earths crust such as arsenic, which can weather and become airborne. Regional air masses reflect long-term air transport and dispersion from distant sources as well as local sources.

Table 2-1 presents a summary of the air sampling program, identifying the locations, parameters sampled, and the duration of sampling. Appendix A contains a CD with the field notes, chain of custody documentation and laboratory data.

Note that high winds experienced at the Beallsville site knocked over one of the monitors and personnel at the fire station turned off the power on both monitors on January 23, 2008 at 7:30 PM. An AECOM field technician visited the site and re-started the monitors January 30, 2008 at 5:20 PM following verification that there were no operational issues or problems with the samplers. As such, the dioxin sampling period was extended for the Beallsville monitors to obtain the desired sample duration of 30 days.

2.1   Laboratory Analysis

Consistent with the 2003 sampling program, the metals analysis was be conducted by Katahdin Analytical Services in Scarborough, ME and the dioxins/furans analysis was conducted by Axys Analytical Services in Sidney, British Columbia.

The analytical quality assurance/quality control (QA/QC) program for metals included one matrix spike/matrix spike duplicate (MS/MSD) per matrix for metals; dioxins/furans do not require MS/MSD.

2.2   Sampling Equipment

The samplers used for this project included standard high volume particulate samplers (hivols) and high volume, PS-1/PUF samplers.

2.2.1   Hivol Samplers

The hivols used to sample for metals were the General Metals Model GMS-1 samplers. The sample flow rate of this device is controlled by a built-in mass flow device that maintains the sample rate to within ±1 cubic foot per minute (CFM). The duration of the sample run is controlled with a mechanical timer that can be set to start

and end the sample collection period. An elapsed time meter provides an accurate measure of the sample duration, which will be approximately 24-hours. Samples were collected on standard 8"x10" (20.3 x 25.4 cm) acid-washed binderless glass-fiber filter media.

Hivols were calibrated at the start of the program and at the end. A calibrated orifice certified against a reference standard Roots Meter was used for the calibration. The calibration orifice used was certified within the past year.

2.2.2 PS-1/PUF Samplers

The PS-1/PUF samplers that used to sample for dioxins were modified General Metals Model PS-1 samplers equipped to hold a polyurethane foam (PUF) cartridge and particulate filter. The modification made to the samplers was to replace the standard 4.3-inch (110 mm) circular particulate filter holder cassette with a larger, 8"x10" (20.3 x 25.4 cm) filter holder cassette. This AECOM modification is to allow sampling for dioxins for up to 30 days without replacing the media. A Venturi flow device meters the sample flow rate. The on-board mechanical timer was used to control the duration of the tests; the test duration was controlled manually. The elapsed time indicator on each sampler was used to record the duration of the test.

The PS-1/PUF samplers were calibrated at the start of the program and calibration-checked at the end of the sample period. A calibrated orifice certified against a reference standard Roots Meter was used for the calibration. The orifice that was used was certified within the past year.

Table 2-1: Montgomery County Air Monitoring Program Summary – Winter 2008

Chemical Class	Sites Monitored	Sampling Period	Notes
Metals	Lucketts ("Background")	1/10/08-1/11/08; 1/25/08-1/26/08; 2/3/08-2/4/08	24 hour samples
	Beallsville ("Impact")	1/10/08-1/11/08; 1/25/08-1/26/08; 2/3/08-2/4/08	24 hour samples
Dioxins/Furans	Lucketts ("Background")	1/10/08-2/11/08	32 day sample
	Beallsville ("Impact")	1/10/08-2/16/08*	30 day sample
Co-located samples were collected for all tests at the Beallsville site. Field blanks and trip blanks were also included as part of the test protocol. * The co-located Beallsville monitors were down during January 23, 2008 at 7:30 PM through January 30, 2008 5:20 PM.			

3.0 Field Operations

The Beallsville monitors ("impact" site) were located at the volunteer fire station in Beallsville, MD. The primary and collocated hivol samplers at this location were placed on the peaked roof of the picnic table cover at the baseball field adjacent to the fire station. Penetrations into the roof were not allowed so each sampler was secured to a pair of wooden 2"x4" boards and the boards were weighted with cement blocks. Spacing between the primary and collocated samplers was approximately two meters.

The Lucketts monitors ("background" site) were located on the roof of the Lucketts, VA elementary school which is a single story building. The roof is approximately 20 feet above the ground. The hivol and PS-1 samplers were placed approximately 2 meters apart on the roof.

Photographs of the monitoring locations are shown in Figures 3-1 and 3-2.

3.1 Metals Tests

Samples for metals analysis were collected on three separate occasions over the sampling program period, which was approximately 30 days in duration. Each sample test cycle was approximately 24 hours. The metals tests during the winter were conducted during1/10/08-1/11/08; 1/25/08-1/26/08; and 2/3/08-2/4/08. In each test, the hivols were set to operate at a sample flow rate between 40-50 actual cubic feet per minute (ACFM) or 1,133-1,416 actual liters per minute (ALPM). Glass-fiber filters were installed in the hivols at the start of each test and removed within 24 hours after the end of the test

3.2 Dioxin Tests

A single dioxin sampling run was conducted over the entire monitoring period at each of the two monitoring locations. The monitoring period for the Beallsville monitors was 1/10/08-2/16/08 and the period for the Lucketts monitor was 1/10/08-2/11/08. The sample collection media (glass fiber filter and PUF cartridge) was installed in each sampler at the start of the test period and recovered at the end of the sample period. At the start of the test, each sampler was set to operate at a flow rate of approximately 6.4 standard cubic feet per minute (SCFM) or 180 standard liters per minute (SLPM). Each week during the test period the samplers were checked and the flow rate was adjusted if necessary

3.3 Sample Shipment

The metals sample filters were shipped under chain of custody documentation to Katahdin Analytical Services in Scarborough, ME. The dioxin samples were placed in a cooler with "blue ice" cold packs and shipped under chain of custody documentation to Axys Analytical Services in Sidney, British Columbia. These are the same laboratories used in the last air monitoring program and recent (June 2007) non-air media program.

Figure 3-1: Samplers Installed on Pavilion Roof at Beallsville Fire Station

Figure 3-2: Samplers Installed on Roof Top of Lucketts School

4.0 Results

AECOM reviewed the laboratory data and computed air concentrations based on the calibration of the samplers used for this program. Total volumes from the average of pre- and post- calibration data were calculated at standard conditions of 25°C and 760 mm/Hg. The volumes are included in the results tables presented below in Tables 4-1.

4.1 Metals

As part of the ongoing ambient monitoring program in the vicinity of the RRF, air sampling for selected metals was conducted during the winter 2008 at two sites, the Beallsville ("impact") site and the Lucketts ("background") site, which is consistent with previous studies. Results for the metals are presented below. In addition, the metals data collected during the pre-operational phase program (February 1994 - February 1995), first operational phase program (February 1996 to August 1996) and second operational phase program (December 10, 2002 through January 8, 2003 and May 21 through June 23, 2003) are included for comparison purposes.

Metals sampling was conducted at the Beallsville site during all previous programs. Note that metals were not sampled at the Lucketts site during the pre-operational phase and first operational phase programs [The Lucketts site had been used to sample only for dioxins/furans during the first two programs]. However, metals sampling data were available from the Burtonsville location during the first two programs. Burtonsville had served as the background site during the pre-operational and first-operational phase programs. The Burtonsville location, similar to Lucketts, was a location where dispersion modeling indicated insignificant air concentrations from RRF emissions. Therefore, for the purposes of comparing the sampling results from the current programs with the previous programs, data from Beallsville, Lucketts and Burtonville were used as available.

4.1.1 Third Operational Phase (2008) Results – Metals

Ambient air monitoring included the collection and analysis of filter samples for particulate-associated metals. The laboratory analysis technique selected for the program used X-ray fluorescence, which detects an extensive list of metals and other inorganic elements simultaneously. The exception to this was the analysis for mercury, which employed the atomic absorption spectroscopy method. Sampling was conducted for the following metals: mercury, arsenic, beryllium, cadmium, chromium, lead and nickel. These metals include the carcinogens (arsenic, cadmium, chromium, and nickel) and non-carcinogens (beryllium, mercury and lead) known to cause health effects.

Samples were collected using a high-volume sampler, which collected particulates in air on acid-washed binderless glass fiber media. A summary of the metals results is provided in Table 4-1. As shown in Table 4-1, all metals were reported as either not detected (denoted with an asterisk; "*") or detected in relatively low concentrations. Note that consistent with general practice for metals air sampling, and consistent with the data reported in the previous programs, the non-detected values were reported as half of the detection limit. All metals were detected with the exception of beryllium which was not detected in any sample and mercury which had a number of non-detects. Also note that chromium and nickel concentrations were detected in the trip blank and field blank at levels generally comparable, but lower than the filter samples collected at both Lucketts and Beallsville. Although the sample filters are high purity filters, they are glass fiber filters which are known to have very low trace metal content. As the concentrations in the filter samples were found to be higher levels than the trip and field blanks, they were reported as detected.

The metals results for the three 24-hour sampling events are shown graphically in Figures 4-1, 4-2 and 4-3.

4.1.2   Comparison with Historical Data – Metals

Figure 4-4 presents metals data from all three programs conducted to date including data from the pre-operational, first operational, and the second operational phases. A discussion for each metal is provided.

Mercury

Mercury was not detected during the pre-operational and first operational phase monitoring programs (1996-1997) but was detected in some samples during the 2002-03 and 2008 programs which had lower detection limits compared to the first two programs. Reported mercury concentrations have been the lowest of all metals as shown in Figure 4-4.

Arsenic

Arsenic had infrequently been detected during the first three monitoring programs and reported concentrations were predominantly based on detection limits (i.e., ½ the detection limit). Due to the lower detection limits achieved by the laboratory in 2008, arsenic was detected in all samples and the 2008 concentrations are higher than previous programs where concentrations were reported at half the detection limit. Reported concentrations at the Beallsville location are slightly higher in 2008 while the concentrations measured at Lucketts in 2008 are about twice as high as previous programs.

Beryllium

Beryllium has never been detected during any of the air measurement programs.   The lower concentrations reported in 2008 and 2002-2003 (second operational phase) were due to the lower detection limits achieved by the laboratory.

Cadmium

Cadmium had only been detected in a few samples throughout the previous measurement programs but was detected in all 2008 samples due to lower detection limits. The concentrations measured in 2008 were lower than concentrations reported in previous programs.

Chromium

Chromium concentrations were detected in most samples during all four programs. As shown in Figure 4-4 the concentrations measured during 2008 are lower than in 2002-03 but within the range of concentrations measured throughout the monitoring program.

Lead

Lead was commonly detected during all four monitoring programs at all sites. As shown in Figure 4-4, lead concentrations for the different programs and monitoring locations were 6.5 ng/m^3 or less, compared to the U.S. EPA National Ambient Air Quality Standard (NAAQS) of 150 ng/m^3. The lead concentrations measured at Beallsville during 2008 were lower than those measured in 2002-03 while concentrations at Lucketts in 2008 were higher than 2002-03 and the other programs.

Nickel

Nickel was detected in most samples taken during all monitoring programs. As shown in Figure 4-4, concentrations measured during 2008 comparable to concentrations measured during the previous programs.

In summary, there are no obvious patterns or trends in comparing pre-operational and operational phase monitoring data. The data indicate that in general, concentrations measured during 2008 are similar to or lower than data measured during the pre-operational phases and previous operational programs, with the exception of arsenic. For arsenic, the concentrations measured during 2008 at the Beallsville location, are comparable but slightly higher than previous programs and the 2008 Lucketts concentration is about twice as high as the concentrations measured during previous programs. The difference is in part attributable to the lower detection limits achieved by the laboratory in 2008.

4.2   Dioxins and Furans

As part of the ongoing ambient monitoring program in the vicinity of the RRF, air sampling for PCDDs/PCDFs was also conducted during the winter 2008 at the Beallsville and Lucketts sites. Results for the PCDDs/PCDFs are presented below for the third operational phase monitoring and compared with data collected in the previous monitoring programs. PCDDs/PCDFs sampling data are available for the Beallsville and Lucketts sites for all monitoring programs.

Undetected congeners are a source of uncertainty. That is, the undetected congener may exist at any level between zero and its laboratory detection limit. When interpreting the results, the actual concentration of the congener may be assumed to be zero, or it may be assumed to exist at the detection limit. For the PCDD/PCDF trend analysis, in the calculation of a toxic equivalent (TEQ), the congener-specific uncertainty is compounded by combining (summing) laboratory results for all seventeen congeners, any number of which may be non-detects. Other than stating the assumptions used for reporting non-detected values, there is no "standard" way to handle non-detects in the calculation of TEQ values. To show the range of TEQs that could be calculated depending on the treatment of detection limits, TEQs were calculated two ways: 1) assuming zero values for all non-detects and 2) assuming non-detects are present at a concentration equal to the detection limit. We note the following regarding the results reported using both these approaches. The TEQ is potentially underestimated when using only the detected congeners (i.e., undetected congeners assumed to be zero). The reported TEQ is overestimated when using detection limits to represent non-detects.

4.2.1   Third Operational Phase (2008) Results - PCDDs/PCDFs

PCDDs/PCDFs (polychlorinated dibenzodioxins and polychlorinated dibenzofurans) are a class of 210 related chlorinated organic compounds that have been associated with carcinogenic and reproductive effects in humans. They are formed during various industrial processes, and by combustion. Municipal resource recovery facilities, sewage sludge incinerators, hazardous waste and hospital waste incinerators, coal-fired power plants and furnaces and wood-burning operations all contribute to PCDDs/PCDFs in ambient air. As the most toxic of potential emissions from the RRF, they have been of particular concern to the citizens of the area.

The air sampling and analysis for PCDDs/PCDFs generated data for the ten individual PCDFs and seven individual PCDDs with 4 to 8 chlorines considered primarily responsible for the health risks. The seventeen individual PCDDs/PCDFs measured have been assigned toxic equivalency factors (TEF; see Table 4-2), and these are used to assess the health risk associated with the presence of these chemicals. The overall toxicity of a sample is calculated by multiplying the concentration values for each of the 17 PCDDs/PCDFs by its TEF. These 17 values are added together to calculate a toxic equivalents (TEQ) value for the sample. Note that the most recent TEFs available from the World Health Organization (van den Berg 2006) were used to determine the TEQs.

Levels of the seventeen dioxins and furans congeners with assigned TEFs in ambient air are frequently below the sensitivity of the sampling and analysis method for 24-hour ambient air samples; for that reason, samples were collected over a 30-day period. This approach provided an increased sample volume resulting in

enhanced method sensitivity. This same approach was first introduced to the program during the second operational phase sampling conducted in 2002-2003.

The PCDDs/PCDFs results for the 2008 sampling program are summarized in Table 4-2. Data are summarized for the dioxin and furan congeners for both monitoring locations. The computed TEQs are provided in the last row of the table. Results for the seventeen 2,3,7,8-substituted congeners and total tetra through octa PCDDs/PCDFs are presented graphically in Figures 4-5 and 4-6, respectively. The air concentrations of individual PCDDs/PCDFs at both sites were detected in all cases.

4.2.2   Comparison with Historical Data - PCDDs/PCDFs

As discussed above, given uncertainties associated with non-detected congeners, PCDDs/PCDFs TEQ values were calculated two ways to show the range of TEQs that could result depending on the treatment of detection limits: 1) assuming zero values for all non-detects and 2) assuming non-detects are present at a concentration equal to the detection limit. Figures 4-7 and 4-8 present PCDDs/PCDFs TEQ results from the preoperational (1994), first operational (1996-1997), second operational (2002-2003) and third operational phases (2008) based on non-detects at the full detection limit and non-detects as zero concentrations, respectively.

In Figure 4-7, where non-detects are represented by detection limits, TEQ values from the third operational phase (2008) are slightly lower than the second operational phase data (2002-2003), and data from these operational phases appear to be much lower than the preoperational phase (1994) and first operational phase (1995-1996) data. The latter is primarily due to the improvement of detection limits for the second and third operational phases compared to the preoperational phase and first operational phases. The second and third operational phase data, which have improved detection limits, indicate ambient levels are not increasing, and possibly decreasing.

For the case where non-detects are assumed to be zero (see Figure 4-8), the third operational phase TEQ data are slightly lower than the second operational phase data for both the Beallsville ("Impact") and Lucketts ("Background") sites. Figure 4-8 also shows that Beallsville TEQ data for all operational phases are lower than for the preoperational phase, while the Lucketts TEQ data for the second and third operational phases are higher than for the first operational and preoperational phases. It is difficult to draw conclusions from comparison of the second and third operational data to the first operational and pre-operational data where many congeners were not detected. The second and third operational phase data, where most congeners were detected, indicate ambient levels are not increasing, and possibly decreasing.

Table 4-1:   Montgomery County Air Monitoring Program – 2008 Metals Results

		Jan. 11/08						Jan. 25/08					
SAMPLE ID		138619		138620		138621		138623		177474		138622	
SITE		Beallsville (prime)		Beallsville (colo)		Lucketts		Beallsville (prime)		Beallsville (colo)		Lucketts	
SAMPLE VOLUME (m³)		1,701		1,765		1,277		1560		1732		1322	
Parameter	Detection Limit (ug)	ug	ug/m³	ug	ug/m³	ug	ug/m³	ug	ug/m³	ug	ug/m³	ug	ug/m³
Mercury	0.02	0.01 *	0.00001	0.01 *	0.00001	0.01 *	0.00001	0.03	0.00002	0.01 *	0.00001	0.03	0.00002
Arsenic	0.61	2.10	0.00123	1.20	0.00068	3.20	0.00251	2.50	0.00160	1.40	0.00081	1.40	0.00106
Beryllium	0.04	0.02 *	0.00001	0.02 *	0.00001	0.02 *	0.00002	0.02 *	0.00001	0.02 *	0.00001	0.02 *	0.00002
Cadmium	0.04	0.29	0.00017	0.23	0.00013	0.27	0.00021	0.30	0.00019	0.13	0.00008	0.23	0.00017
Chromium	0.14	2.8 B	0.00165	2.5 B	0.00142	2.6 B	0.00204	2.5 B	0.00160	2.6 B	0.00150	4.0 B	0.00303
Lead	0.50	5.0	0.00294	2.6	0.00147	5.1	0.00399	4.4	0.00282	1.9	0.00110	4.8	0.00363
Nickel	0.11	2.50 B	0.00147	1.80 B	0.00102	2.30 B	0.00180	2.00 B	0.00128	1.20 B	0.00069	1.80 B	0.00136

		Feb. 3/08						Trip Blank		Field Blank	
SAMPLE ID		138624		138625		177473					
SITE		Beallsville (prime)		Beallsville (colo)		Lucketts					
SAMPLE VOLUME (m³)		1600		1946		1154					
Parameter	Detection Limit (ug)	ug	ug/m³	ug	ug/m³	ug	ug/m³	ug		ug	
Mercury	0.02	0.03	0.00002	0.03	0.00002	0.07	0.00006	0.02 *		0.02 *	
Arsenic	0.61	3.00	0.00188	3.00	0.00154	4.00	0.00347	0.74		0.73	
Beryllium	0.04	0.02 *	0.00001	0.02 *	0.00001	0.02 *	0.00002	0.02 *		0.02 *	
Cadmium	0.04	0.46	0.00029	0.39	0.00020	0.55	0.00048	0.06		0.04	
Chromium	0.14	2.70 B	0.00169	2.50 B	0.00128	4.00 B	0.00347	2.40		1.80	
Lead	0.50	11.3	0.00706	8.0	0.00411	13.7	0.01187	0.5		0.5	
Nickel	0.11	2.00 B	0.00125	1.80 B	0.00092	3.40 B	0.00295	1.20		1.10	

* Value is below detection limit for the parameter, concentration assumed to be at 1/2 the detection limit.

B = Not detected substantially above the level reported in the blank.

(1) Beallsville Fire Station (primary sampler)

(2) Beallsville Fire Station (collocated sampler)
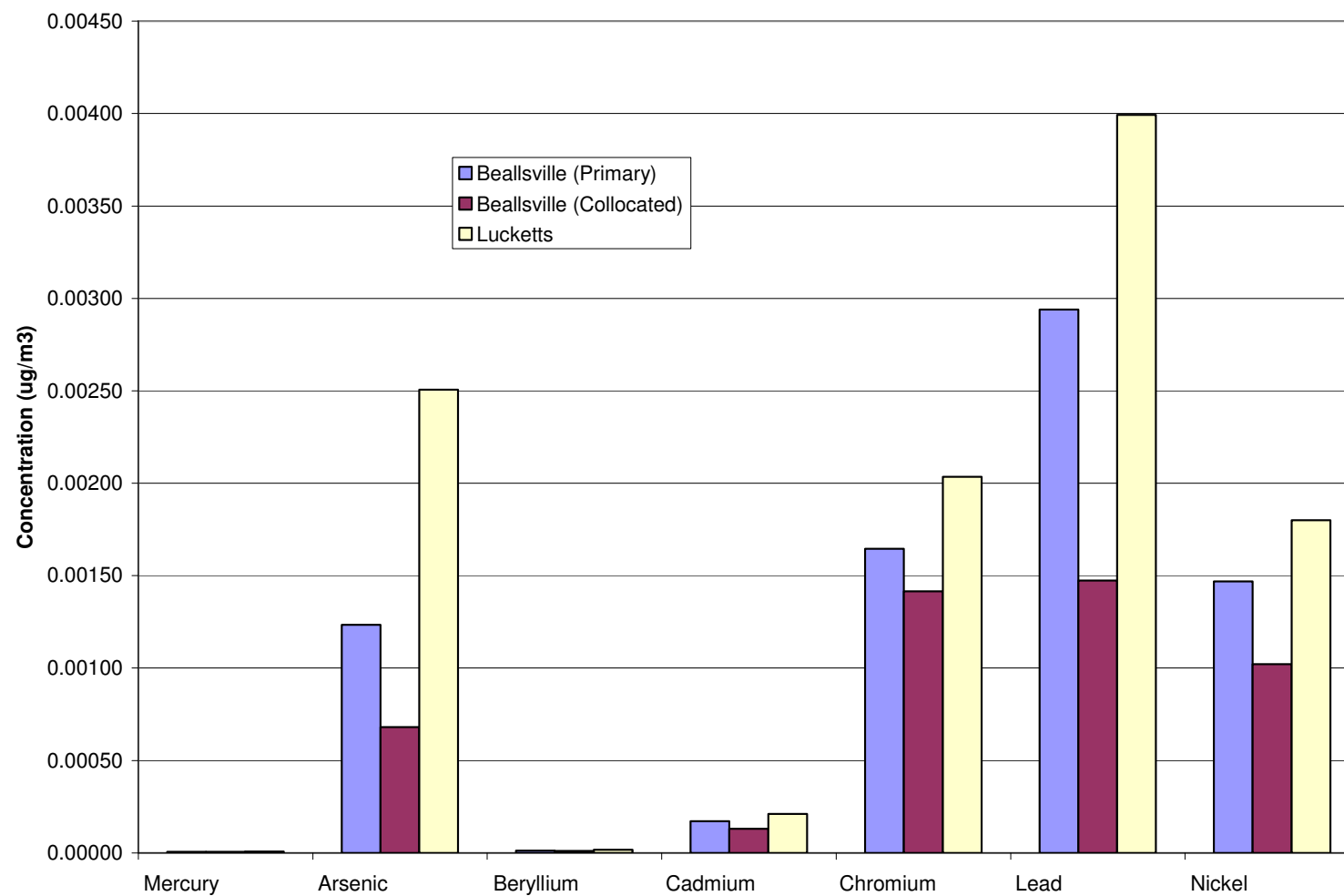
(3) Lucketts Elementary School

Figure 4-1: Montgomery County Air Monitoring Program – 2008 Metals Results January 11
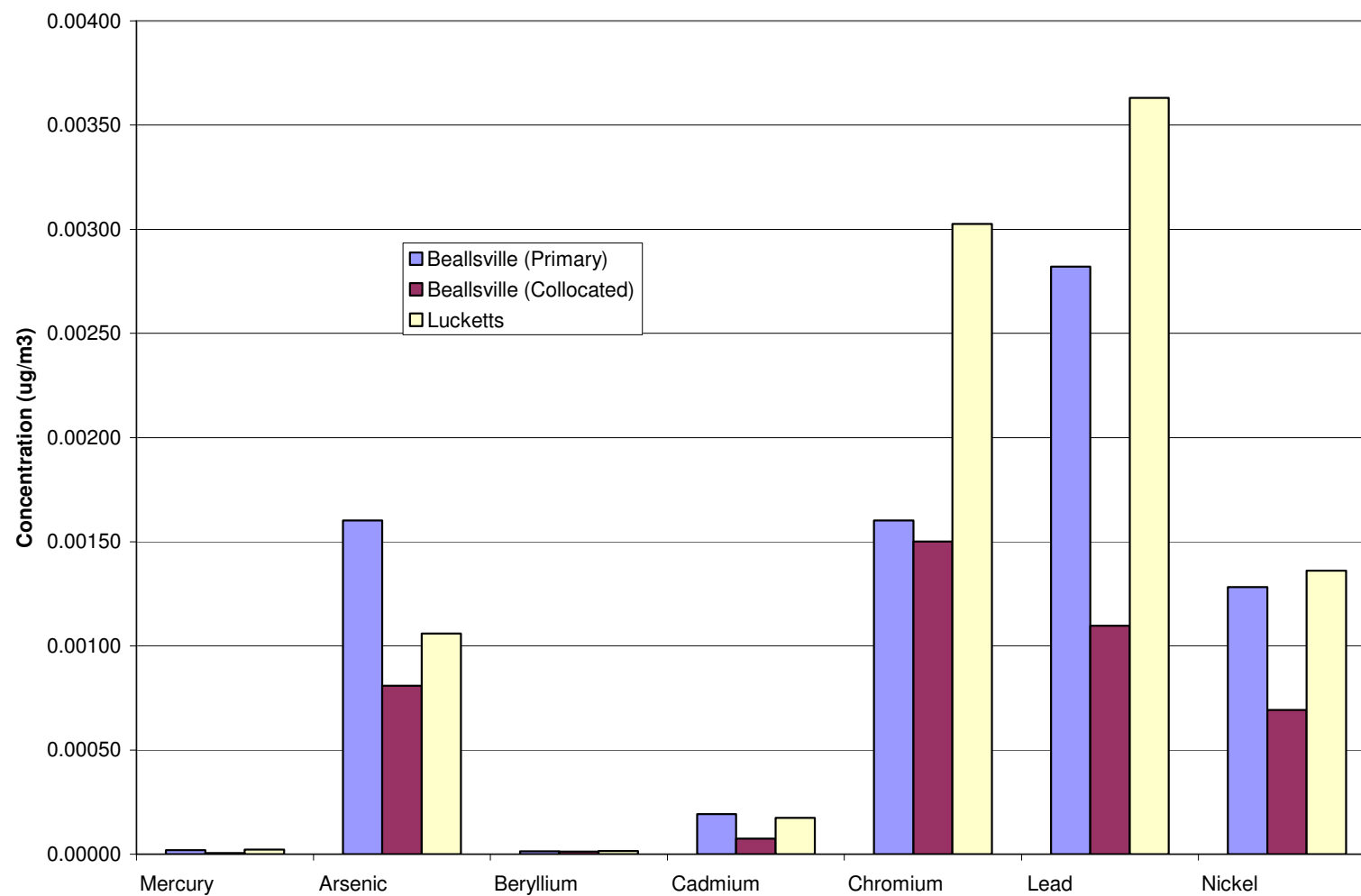
Figure 4-2: Montgomery County Air Monitoring Program – 2008 Metals Results January 25
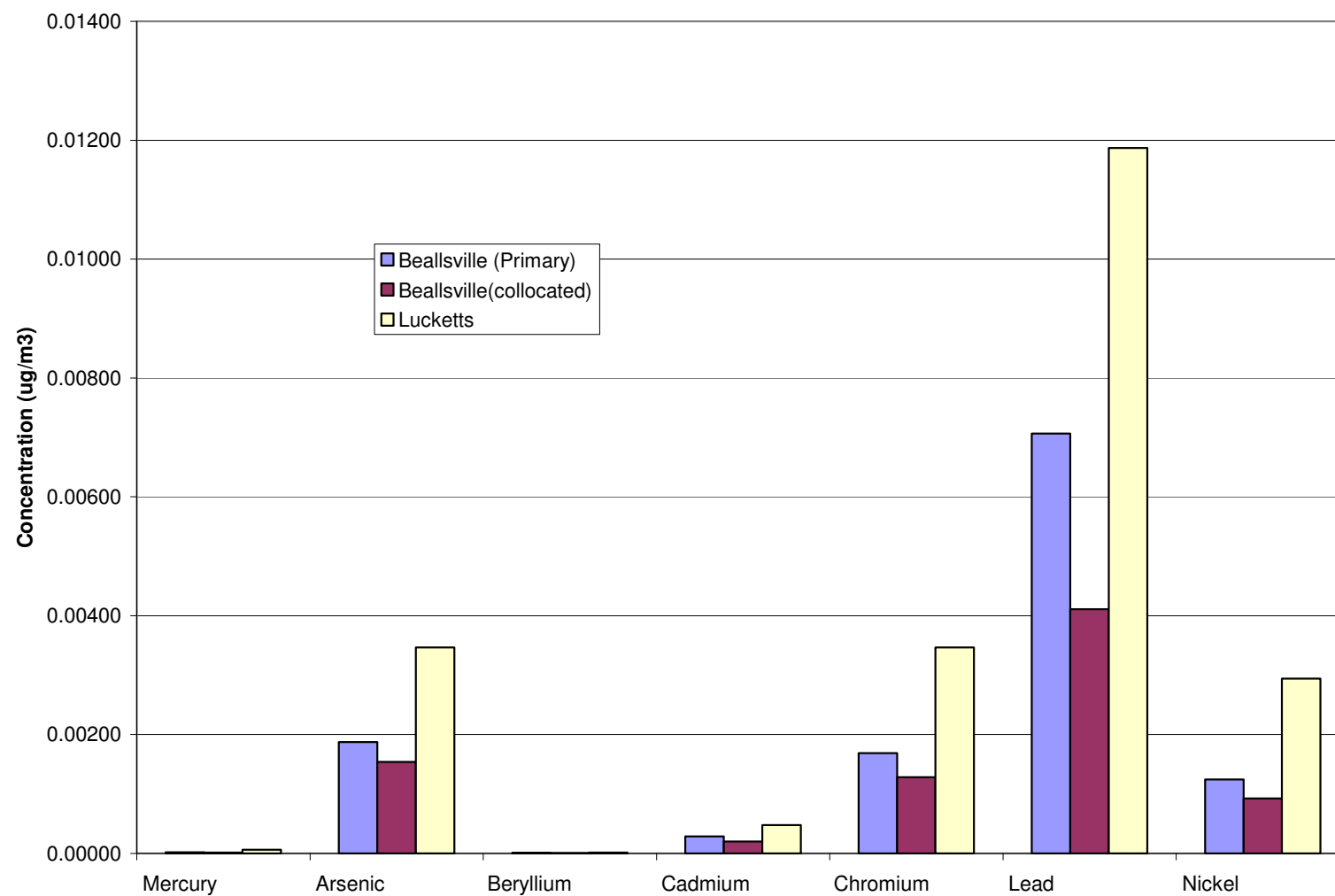
Figure 4-3: Montgomery County Air Monitoring Program – 2008 Metals Results February 3

Figure 4-4: Metals Data Comparison – Pre-Operation, 1996-1997, 2002-2003, and 2008
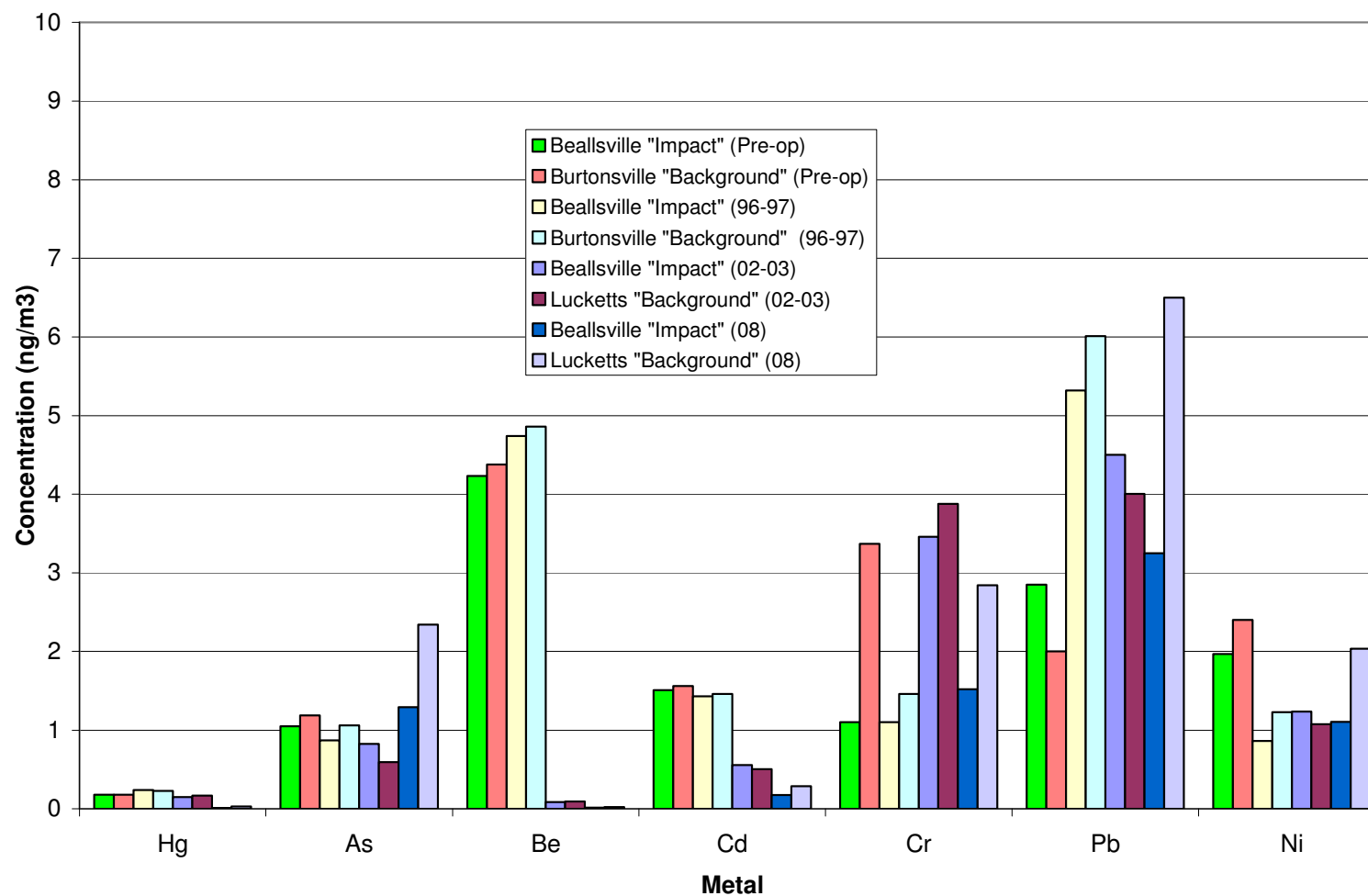
Table 4-2: Montgomery County Air Monitoring Program PCDD/PCDF Homologue Results – Winter 2008

SAMPLE ID		L10742-2		L10742-4		L01742-3		L10742-5		L10742-6	
SITE		Beallsville - ("Impact")		Beallsville - Colocated ("Impact")		Lucketts ("Background")		Field Blank		Trip Blank	
SAMPLE VOLUME (m³)		7,701		7,572		8,043					
Parameter	**TEF**	pg	pg/m³	pg	pg/m³	pg	pg/m³	pg		pg	
Total Cl4-TCDF	0.0000	969	0.1258	914.00	0.1207	998	0.1241	0.50	*	0.50	*
Total Cl 5 PeCDF	0.0000	617	0.0801	610.00	0.0806	660	0.0821	0.50	*	0.50	*
Total Cl 6 HxCDF	0.0000	557	0.0723	540.00	0.0713	671	0.0834	0.50	*	0.50	*
Total Cl 7 HpCDF	0.0000	488	0.0634	485.00	0.0641	566	0.0704	0.50	*	0.62	
Cl 8 OCDF	0.0003	243	0.0316	225.00	0.0297	176	0.0219	0.50	*	0.50	*
Total Cl 4 TCDD	0.0000	253	0.0329	241.00	0.0318	303	0.0377	0.50	*	0.50	*
Total Cl 5 PeCDD	0.0000	387	0.0503	371.00	0.0490	552	0.0686	0.50	*	0.50	*
Total Cl 6 HxCDD	0.0000	1090	0.1415	1010.00	0.1334	1580	0.1964	0.50	*	0.50	*
Total Cl 7 HpCDD	0.0000	2390	0.3103	2200.00	0.2905	3780	0.4700	1.32		0.50	*
Cl 8 OCDD	0.0003	4250	0.5519	3510.00	0.4635	5640	0.7012	7.91		2.78	
2,3,7,8-Cl 4TCDF	0.1000	22.10	0.0029	20.80	0.0027	79.80	0.0099	0.50	*	0.50	*
2,3,7,8-Cl 4 TCDD	1.0000	6.53	0.0008	5.98	0.0008	7.30	0.0009	0.50	*	0.50	*
1,2,3,7,8-Cl 5-PeCDF	0.0300	24.90	0.0032	22.80	0.0030	16.40	0.0020	0.50	*	0.50	*
2,3,4,7,8-Cl 5-PeCDF	0.3000	38.20	0.0050	37.00	0.0049	43.30	0.0054	0.50	*	0.50	*
1,2,3,7,8-Cl 5-PeCDD	1.0000	38.30	0.0050	33.50	0.0044	46.30	0.0058	0.50	*	0.50	*
1,2,3,4,7,8-Cl 6-HxCDF	0.1000	55.00	0.0071	53.20	0.0070	66.20	0.0082	0.50	*	0.50	*
1,2,3,6,7,8-Cl 6-HxCDF	0.1000	46.50	0.0060	46.30	0.0061	54.40	0.0068	0.50	*	0.50	*
2,3,4,6,7,8-Cl 6-HxCDF	0.1000	60.60	0.0079	57.70	0.0076	72.50	0.0090	0.50	*	0.50	*
1,2,3,7,8,9-Cl 6-HxCDF	0.1000	3.84	0.0005	2.00	0.0003	5.88	0.0007	0.50	*	0.50	*
1,2,3,4,7,8-Cl 6-HxCDD	0.1000	52.10	0.0068	46.10	0.0061	89.70	0.0112	0.50	*	0.50	*
1,2,3,6,7,8-Cl 6-HxCDD	0.1000	90.50	0.0118	82.60	0.0109	217	0.0270	0.50	*	0.50	*
1,2,3,7,8,9-Cl 6-HxCDD	0.1000	147	0.0191	131	0.0173	293	0.0364	0.50	*	0.50	*
1,2,3,4,6,7,8-Cl 7-HpCDF	0.0100	284	0.0369	288	0.0380	327	0.0407	0.50	*	0.62	
1,2,3,4,7,8,9-Cl 7-HpCDF	0.0100	34.20	0.0044	28.50	0.0038	40	0.0050	0.50	*	0.50	*
1,2,3,4,6,7,8-Cl 7-HpCDD	0.0100	1100	0.1428	1000	0.1321	201	0.0250	1.32		0.50	*
1,2,3,4,6,7,8,9-Cl 8-OCDF	0.0003	243	0.0316	225	0.0297	257	0.0320	0.50	*	0.50	*
1,2,3,4,6,7,8,9-Cl 8 OCDD	0.0003	4250	0.5519	3510	0.4635	5640	0.7012	7.91		0.50	
	TEQ		**0.016**		**0.015**		**0.020**				

**van den Berg, et.al, 2006. "The 2005 World Health Organization Re-evaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-like Compounds"

http://toxsci.oxfordjournals.org/cgi/content/abstract/kfl055v1?ijkey=pio0gXG6dghrndD&keytype=ref

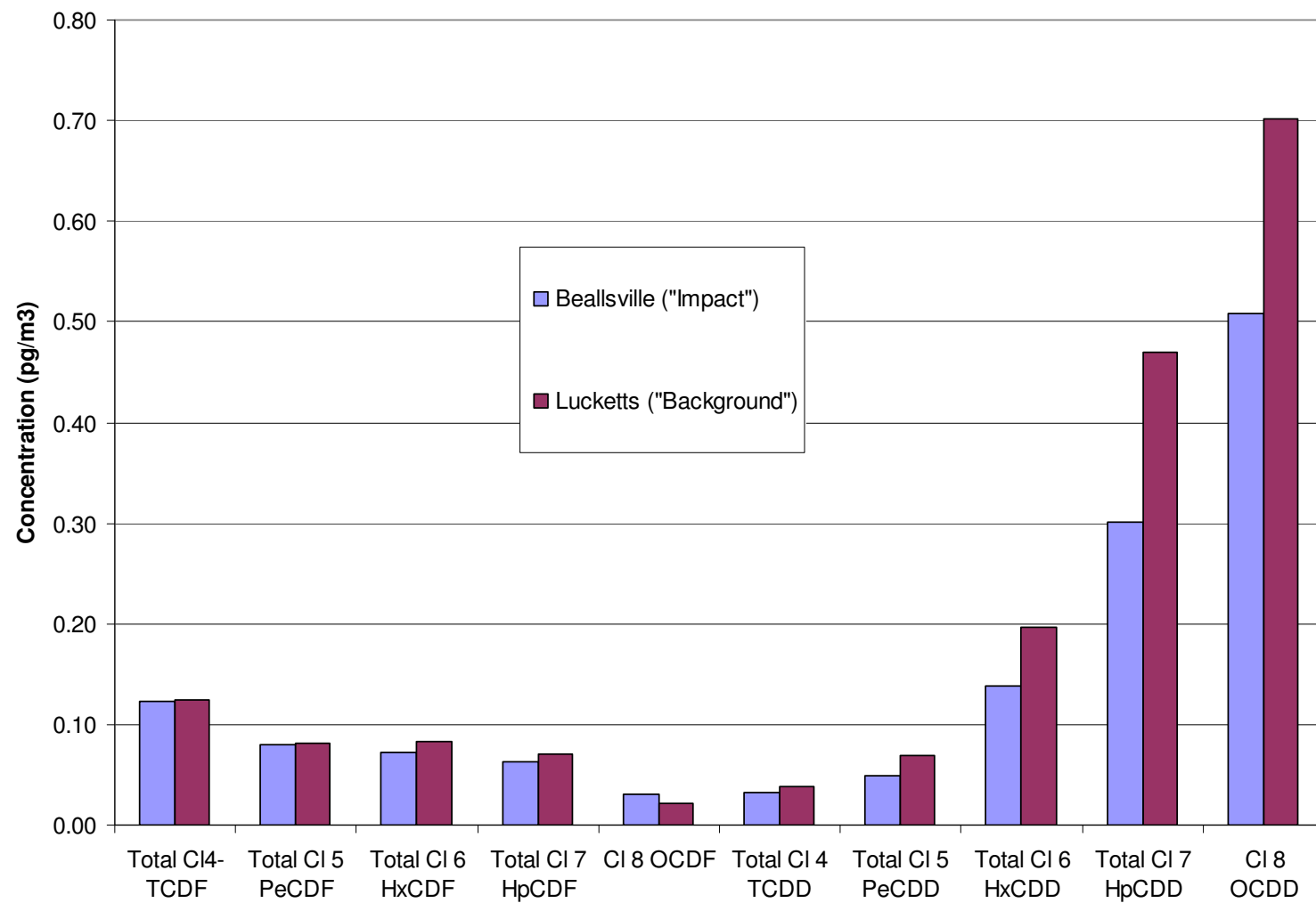(*) = parameter not detected; detection limit used for concentration

Figure 4-5: Montgomery County Air Monitoring Program Total PCDDs /PCDFs – Winter 2008

Figure 4-6: Montgomery County Air Monitoring Program PCDDs / PCDFs Congeners – Winter 2008
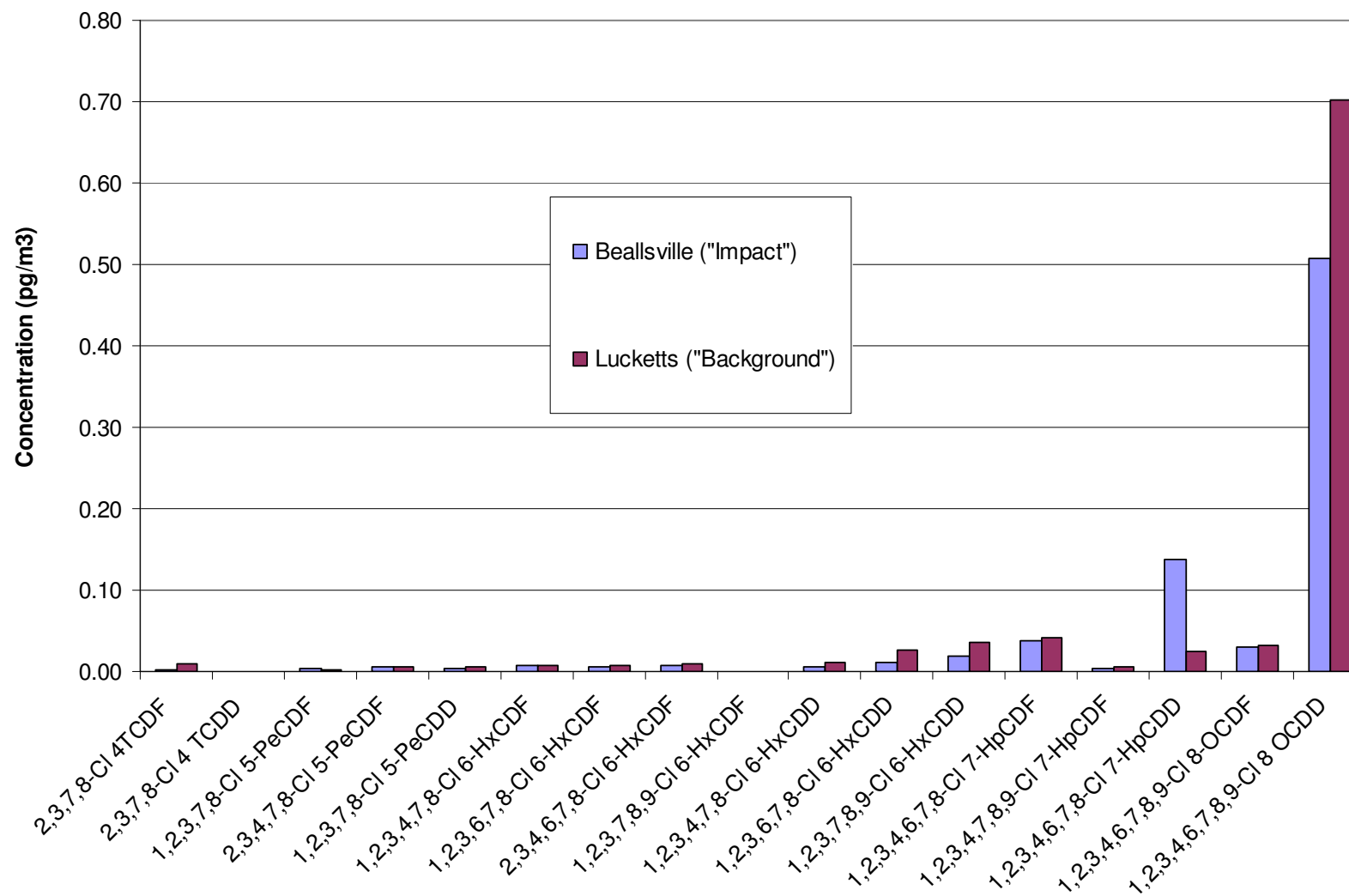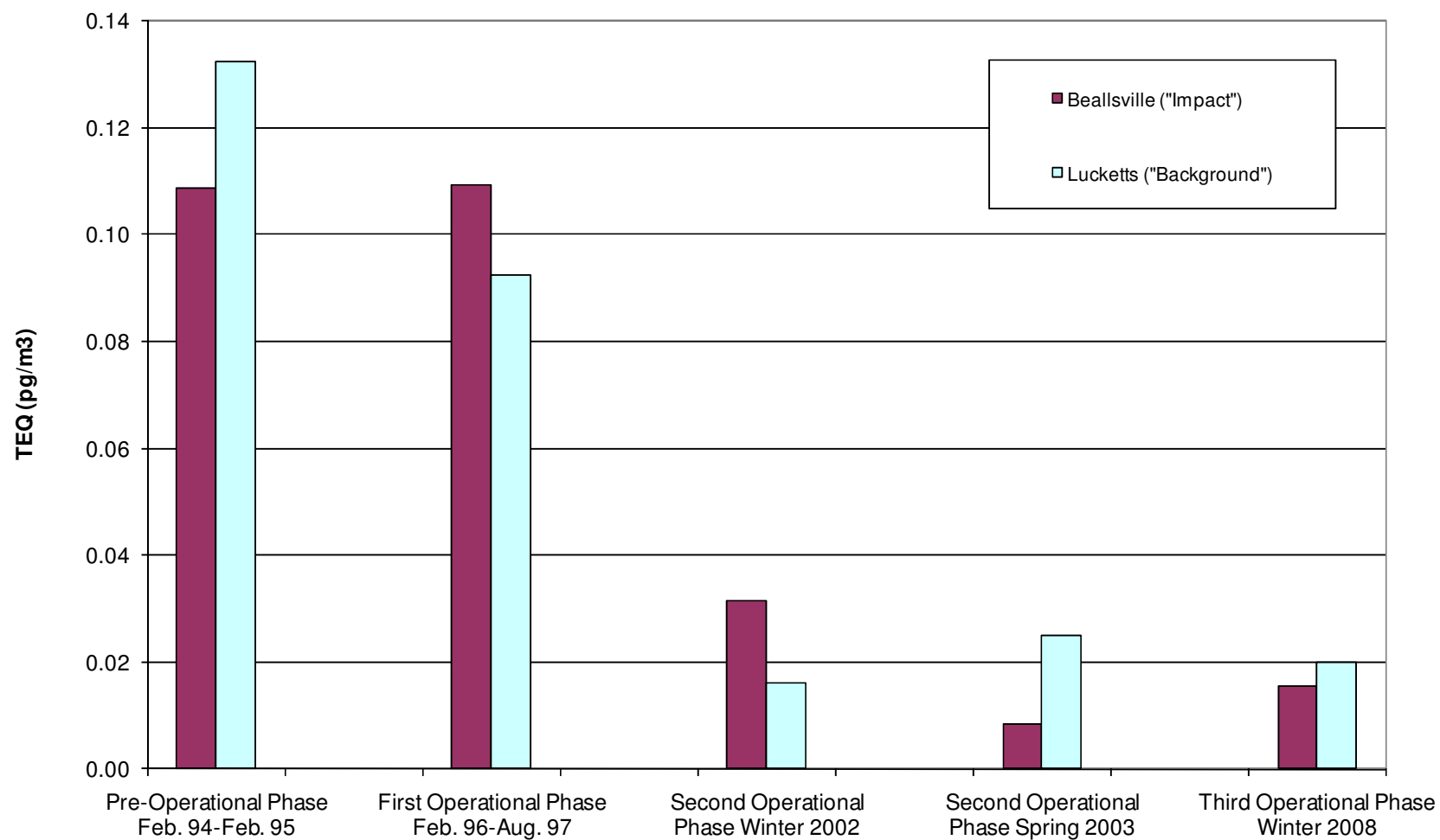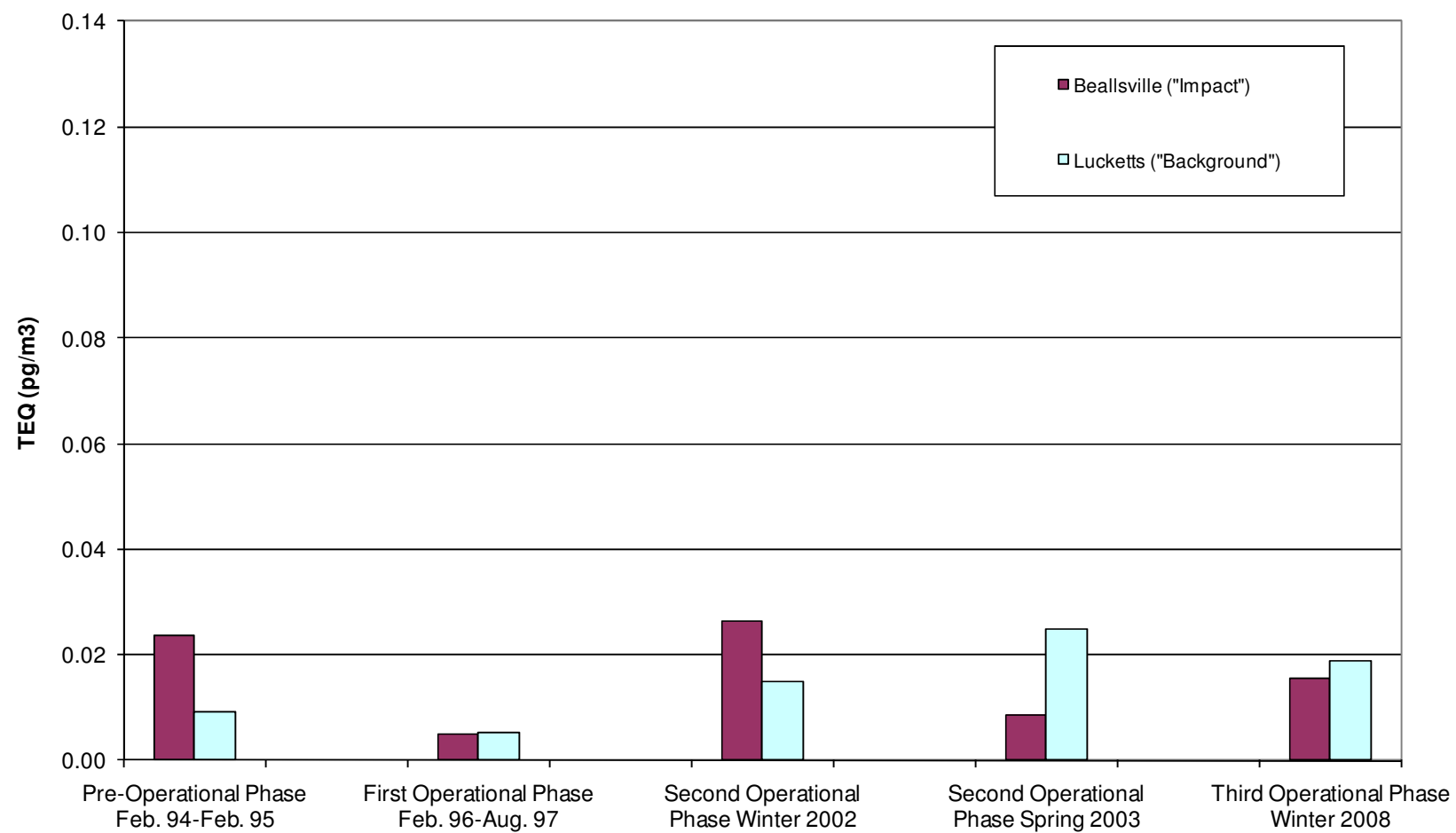
Figure 4-7: PCDDs / PCDFs Data Comparison – Pre-Operational Phase and Operational Phase Programs – Non Detects at Full Detection Limits

Figure 4-8: PCDDs / PCDFs Data Comparison – Pre-Operational Phase and Operational Phase Programs – Non Detects at Zero Concentrations

5.0   Conclusions and Recommendations

As part of the ongoing ambient monitoring program in the vicinity of the RRF, air sampling for selected metals and dioxins/furans (PCDDs/PCDFs) was conducted during winter 2008 at the Beallsville (downwind, "impact") and Lucketts (upwind, "background") sites. The program results indicate that the air contains background levels of the target metals and PCDDs/PCDFs. The PCDDs/PCDFs detected are typical of numerous combustion sources, including the coal-fired electric power generation, home wood burning and vehicle emissions. Given uncertainties associated with non-detected congeners, TEQs were calculated two ways to show the range of TEQs that could result depending on the treatment of detection limits: 1) assuming zero values for all non-detects and 2) assuming non-detects are present at a concentration equal to the detection limit. Based on the assumption that non-detects are present at detection limit concentrations, the levels of PCDDs/PCDFs indicate a potentially decreasing trend over time. TEQ values from the third operational phase (2008) and second operational phase data (2002-2003) appear to be much lower than the preoperational phase (1994) and first operational phase (1995-1996) data. This is primarily due to the improvement of detection limits for the second and third operational phases compared to the preoperational phase and first operational phases. The second and third operational phase data, which have improved detection limits, indicate ambient levels are not increasing, and possibly decreasing.

For the case where non-detects are assumed to be zero, the TEQ data are relatively comparable for all phases with the exception of the first operational phase data which appear to be the lowest measured for both the Beallsville ("Impact") and Lucketts ("Background") sites. The highest TEQ data for Beallsville were measured during the second operational winter phase and the highest data for Lucketts were measured during the second operational spring phase. However, TEQs measured during the third operational winter phase for both Beallsville and Lucketts are lower than these highest values. It is difficult to draw conclusions from comparison of the second and third operational data to the first operational and pre-operational data where many congeners were not detected, but there does not appear to be any trend, increasing or decreasing.

These results are not inconsistent with the predictions of air dispersion and deposition modeling. The updated dispersion and deposition modeling conducted by AECOM (formerly ENSR) for the RRF health risk assessment (HRA) update incorporated as-built stack parameters and measured stack emissions to predict annual air concentration impacts and deposition rates for these same categories of chemicals ("Final Report – Update of Health Risk Study for the Montgomery Solid Waste Resource Recovery Facility", ENSR 2006). The modeled concentrations from the RRF stack emissions, at the location of the maximum in Beallsville, are compared to background concentrations (measured at Lucketts) and the impact site (measured at Beallsville) for the current program in Table 5-1. The RRF emissions data used to model RRF contribution to ambient air concentrations were determined from 2007-2008 stack test data. The modeled increases in air concentrations from the RRF are well below (in most cases several orders of magnitude) the actual background levels of these chemicals measured in the ambient air at the background site in Lucketts. In addition, the modeled ambient air concentrations attributable to the RRF are well below the measured concentrations at the downwind, impact site in Beallsville.

In an effort to give additional meaning to the air monitoring results, Table 5-1 also lists the available U.S. EPA health criteria for dioxins/furans and the metals monitored. Of all the species monitored, lead is the only one for which the U.S. EPA has established a National Ambient Air Quality Standard (NAAQS). For each of the others, there is no NAAQS, and in lieu of a NAAQS, reference is made to the U.S. EPA Region 3 "Regional Screening Levels" (RSLs) for Chemical Contaminants at Superfund Sites (U.S. EPA 2009; http://www.epa.gov/reg3hwmd/risk/human/index.htm). Both NAAQS and RSLs are developed by the U.S. EPA, but quite different from the NAAQS, RSLs are not air standards, but they are risk-based screening levels developed by U.S. EPA to evaluate potential exposure to air contaminants via inhalation associated with Superfund remedial activities. However, RSLs for ambient air are based on long-term residential exposure

and consider both non-cancer and cancer effects (if applicable), and have some reference value. Arsenic and Chromium concentrations measured at both Lucketts and Beallsville exceed their respective RSLs and were therefore highlighted (bold font) in Table 5-1. It is important to note that exceedance of an RSL does not necessarily indicate that a health risk exists. For example, levels of arsenic and chromium measured in ambient air at both sampling locations are consistent with, or lower than, the ranges of these metals reported in other remote areas in the U.S.[1] For additional context regarding arsenic, the European Union recently adopted a "Target Value" of 6.0 ng/m^3 (equivalent to 6,000 x 10^{-6} µg/m^3 in terms of Table 5-1)[2] which value is not exceeded by any actual concentration monitored by the County.

To assess health risks attributable to the RRF, the County conducted the health risk assessment (HRA), noted above, which incorporates air dispersion modeling that predicts maximum increments to ground level ambient air concentrations attributable to the RRF.

It should be noted that the range of observed arsenic and chromium concentrations at the Beallsville (downwind) impact site was lower than at Lucketts (upwind). This is the reverse of what one would expect if there were any appreciable contribution from the RRF. Thus, it can be stated that the monitoring of actual ambient air concentrations during the winter of 2008, reviewed in this report, are not inconsistent with the assumption that the air dispersion modeling conducted by the County in its HRA incorporated accurate, or at least conservative (e.g. overstated), impacts on ambient air concentrations attributable to the RRF. It is beyond the scope of this study to determine the origin of other emissions that contribute to monitored ambient air concentrations.

As shown in Table 5-1, the modeled increases to ambient air concentrations attributable to RRF emissions are orders of magnitude below the RSLs and NAAQS. In addition, Table 5-1 shows that measured concentrations from the background site are also below the RSLs and NAAQS with the exception of arsenic and chromium which exceed the RSLs.

Because the facility is equipped with state-of-the-art air pollution control equipment, actual air emissions from the RRF stack are extremely low and therefore, the modeled concentrations indicate that incremental changes in the air media for most chemicals are several orders of magnitude below the background levels. In fact, the modeled ambient air concentrations attributable to the RRF are so low that any changes in concentration of these metals or dioxins/furans from the RRF at the levels predicted by the modeling would be within the normal variability of the sampling and analysis methods available, and therefore not detectable.

While there are no indications in the data sets collected for the pre-operational and operational phase programs that the RRF is impacting ambient air quality, as the facility ages, periodic monitoring (once every five years) for the same set of selected chemicals emitted by the RRF is recommended. This would provide continued assurance, as well as build a sound database for long-term use. This database would ensure that future changes in operation of the RRF or other emission sources in the area could be adequately evaluated for their impact on air quality.

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[1] Reported in Air Quality Guidelines for Europe, Second Edition, WHO Regional Office, Copenhagen, Denmark, 2000): "Mean levels [of arsenic] in ambient air in the United States range from <1 to 3 ng/m3 in remote areas and from 20 to 30 ng/m3 in urban areas" [i.e. <1,000 to 3,000 µg/m3 in terms of Table 5-1] and "Monitoring of the ambient air during the period 1977–1980 in many urban and rural areas of the United States of America showed chromium concentrations to range from 5.2 ng/m3 (24-hour background level) to 156.8 ng/m3 (urban annual average)." The lower end of this range exceeds all values monitored by the County.

Table 5-1: Modeled Concentrations from RRF Emissions Compared to Background Ambient Air Measurements (µg/m^3)

Analyte	Modeled Increase in Air Concentration Due to RRF Emissions at Beallsville (Downwind)[4]	Measured Air Concentrations Third Operational Phase (2008) Lucketts Background (Upwind) Site [3]	Measured Air Concentrations Third Operational Phase (2008) Beallsville Impact (Downwind) Site [3]	RSL for Ambient Air [1]
Dioxins/Furans TEQ	2×10^{-11}	$2,000 \times 10^{-11}$	$1,600 \times 10^{-11}$	$6,400 \times 10^{-11}$
Arsenic	1×10^{-6}	**1,059 to 3,466x10^{-6}**	**680 to 1,875x10^{-6}**	570×10^{-6}
Beryllium	4×10^{-8}	None detected	None detected	$100,000 \times 10^{-8}$
Cadmium	2×10^{-6}	174 to 477×10^{-6}	75 to 288×10^{-6}	$1,400 \times 10^{-6}$
Chromium	2×10^{-6}	**2,036 to 3,466x10^{-6}**	$1,285$ to **1,688x10^{-6}**	$1,400 \times 10^{-6}$
Lead	3×10^{-5}	363 to $1,187 \times 10^{-5}$	110 to 706×10^{-5}	$15,000 \times 10^{-5}$ [2]
Mercury	8×10^{-6}	Non-detect to 61×10^{-6}	Non-detect to 19×10^{-6}	$310,000 \times 10^{-6}$
Nickel	2×10^{-6}	$1,362$ to $2,946 \times 10^{-6}$	693 to $1,470 \times 10^{-6}$	$5,100 \times 10^{-6}$

[1] Regional Screening Levels (RSLs) are conservative, risk-based screening levels developed by U.S. EPA (U.S. EPA 2009; Regional Screening Levels (RSLs), U.S. Environmental Protection Agency, Region 3, http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm, May). The RSLs for ambient air are based on long-term residential exposure and consider both noncancer and cancer effects (if applicable).

[2] National Ambient Air Quality Standard.

[3] Bold values exceed RSL.

[4] Based on 2007-2008 stack test emissions data.

6.0   References

ENSR 2006, "Final Report – Update of Health risk Study for the Montgomery County Solid Waste Resource Recovery Facility", Document # 4739-001-211d, Revised September 2006.

U.S. EPA 1998, Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Part 1, Ambient Air Quality Monitoring Program Quality System Development, August.

U.S. EPA 2009, Regional Screening Levels (RSLs), U.S. Environmental Protection Agency, Region 3, http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm, May.

van den Berg, Martin, et.al, 2006. "The 2005 World Health Organization Re-evaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-like Compound". http://toxsci.oxfordjournals.org/cgi/content/abstract/kfl055v1?ijkey=pio0gXG6dghrndD&keytype=ref

7.0   Glossary

The following terms and phrases are defined specifically for interpretation in the Air Media Sampling Report for the Montgomery County Solid Waste Resource Recovery Facility

1,2,3,4,6,7,8-HpCDF: A furan congener having seven chloride atoms.

1,2,3,4,7,8-HxCDD: A dioxin congener having six chloride atoms.

1,2,3,6,7,8-HxCDF: A furan congener having six chloride atoms.

1,2,3,7,8-PeCDD: A dioxin congener having five chloride atoms.

1,2,3,7,8-PeCDF: A furan congener having five chloride atoms.

2,3,4,6,7,8-HxCDF: A furan congener having six chloride atoms.

2,3,4,7,8-PeCDF: A furan congener having five chloride atoms.

2,3,7,8-TCDD: A dioxin congener having four chloride atoms, and the most toxic of the dioxins and furans.

2,3,7,8-TCDF: A furan congener having four chloride atoms.

Abiotic: Of or characterized by the absence of life or living organisms. The abiotic medium sampled for this Program is surface water.

Acid-Washed Binderless Glass-Fiber Filter Media: Glass fiber filter media is made from 100% micro-fine borosilicate glass fibers. These filters are acid-washed and have an extremely low ash content of 0.01%. Glass fiber filters are used where high flow rate and micron/sub-micron filtration is required.

Airborne: Conveyed by or through the air.

Ambient Conditions: The surrounding area or environment.

Analyte Group: A pre-selected group of test parameters, such as dioxins or metals.

Analyte: A specific test parameter (chemical or compound).

Atomic Absorption Spectroscopy: Atomic Absorption Spectroscopy is an analytical method for determining the concentration of a particular metal element in liquid or solid samples. This technique is used to analyze the concentration of over 70 different metals in a solution.

Baseline Data: Information such as media-specific chemical concentrations collected before operations that may cause an impact to occur. Montgomery County collected baseline data before the RRF became operational.

Bio-accumulate: Bio-accumulation is an accumulation of substances, such as pesticides, organic chemicals in an organism or part of an organism. The accumulation process involves the biological sequestering of substances that enter the organism through respiration, food intake, epidermal (skin) contact with the substance, and/or other means.

Biotic: Pertaining to life or living beings. Biotic media sampled for the Program are hay, milk, and fish.

Calibrate: To set or check the graduation of a quantitative measuring instrument. To check, adjust, or determine by comparison with a standard.

Carcinogens: Chemicals that, at certain high concentrations and exposure, may cause cancer.

Chain of Custody: A documentation or "paper trail" of a sample, from collection through disposal.

Chlorinated: When a chemical contains a chloride atom (Cl-) as part of its make-up.

Co-located Samples: Co-located samples mean that two independently operated sets of monitoring instrumentation are located within approximately 5 to 30 meters of each other; essentially at the same location. Co-located samples are collected to evaluate the overall error associated with collecting, handling, processing, and analyzing the samples.

Congener: A chemical in the same category as another. Congeners are related because of their make-up and are often different by the addition or subtraction of one atom.

Cumulative Toxic Effects: Cumulative toxic effects are the cumulative effects on human health or on the ecosystem with the exposure to mixtures of toxic substances.

Deposition: Where chemicals from the RRF discharge to the air (i.e., emissions) fall to the ground.

Detectable Difference: A difference in measurements that is obvious and undeniable.

Detection Limits (DLs): An estimate of the detection limit the laboratory can achieve. DLs are generated using statistics following specific EPA guidance, and are the lowest concentration (greater than zero) that the laboratory can measure and report 99% confidence. To calculate a DL, laboratories test known concentrations of a chemical (i.e., arsenic) usually in a laboratory pure matrix and, based on the results, calculate a concentration that is the lowest achievable concentration for that chemical in that medium, for that laboratory for the equipment used. DLs vary over time and between labs.

Dioxins/Furans: A group of related compounds (i.e., congeners) that contain different numbers of chloride atoms. Dioxins and furans are known to be carcinogenic.

Duplicate: A QA/QC sample that is created by splitting a single sample into two unique samples for analysis.

Emissions: An act or instance of emitting, to send forth or to discharge.

Environmental: Pertaining to the air, water, minerals, organisms, and all other external factors surrounding and affecting a given organism at any time.

FDA Action Level: A value developed by the U.S. Food and Drug Administration (FDA) indicates a chemical concentration in food (e.g., mercury in fish) that is considered safe for human consumption. When concentrations exceed the action level, advisories may be posted warning the public to limit the amount of that food type ingested.

Field Blank: Field blank is defined as an analyte free medium that is placed in a sample container, shipped to the field and treated as a sample in all respects, including contact with the sampling devices and exposure to sampling site conditions, filtration, storage, preservation, and all analytical procedures

Gaseous: In the vapor form, such as fumes.

Glass Fiber Filter: Glass Fiber Filter is made from 100% high quality borosilicate glass micro fibers. It is designed to be used as a general purpose filtration media. Many glass fiber filter paper grades are used for air sampling.

Health Risk Assessment: Health risk assessments are used to determine if a particular chemical poses a significant risk to human health. Risk assessment helps scientists and regulators identify serious health hazards and determine realistic goals for reducing exposure to toxics.

High Volume Particulate Sampler (HVPS): The high volume air sampler is EPA's Method for sampling total suspended particulates (TSP) in ambient air. HVPS have been used extensively in Federal, state and industrial monitoring networks for the measurement of ambient air quality standards for TSP and are used widely for occupational health monitoring and particulate research studies.

High Volume PS-1/PUF Sampler: Select toxic organic compounds in ambient air are sampled with a modified high volume air sampler using a combination of Polyurethane Foam (PUF) and quartz filter with subsequent analysis by gas chromatography with mass spectrometry detection.

Inorganic: Those chemicals that are not organic. Examples include most metals and metal compounds.

Isopleths: Isopleth is a line drawn on a map through all points of equal value of some measurable quantity. In many meteorologic, oceanographic, or geologic studies some physical or chemical property is examined that varies from place to place on a map.

Lipid: Any of a group of organic compounds comprising fats, waxes, and similar substances that are greasy, insoluble in water, and soluble in alcohol.

Literature Background Levels: Values published in various sources, such as books and journal articles, which describe concentrations of chemicals in media sampled in areas outside the direct influence of the source of contamination.

Matrices: Plural of matrix.

Matrix Spike/Matrix Spike Duplicate: QA/QC samples that are used to provide checks on the laboratory. Known amounts of chemicals are spiked into each matrix and the "recovery", or measurement of added chemical, is quantified.

Matrix: A term used in a laboratory to define a form, such as liquid or solid.

Mechanical Timer: Mechanical timers are used to actuate devices at the end of a specified time period. They do not require electrical power and can be stored for long periods of time.

Media: Describes components of the surrounding environment. Examples of environmental media are air, water, soil, fish, milk, hay, and sediment.

mg/kg: Milligrams per kilogram, or number of parts in a million parts.

Monitoring: The process of observing, detecting, or recording the operation of a system, such as the potential accumulation of chemicals in abiotic media and the food chain.

Multi-Media: More than one medium. For the RRF Monitoring Program, multi-media refers to fish tissue, hay tissue, cow's milk, and water.

Multiplier: A number by which another number is multiplied.

Octa: Having eight. Such as octa-chlorinated compounds that have eight chloride atoms.

Organic: Refers to a class of chemical compounds that include carbon in their composition. Organic compounds are often derived from animal or plant material (e.g., fossil fuels are organic compounds; they are derived from animal and plant material and contain carbon. The burning of fossil fuels produces other organic compounds).

Orifice plate: An orifice plate is a device used to measure the rate of fluid flow. It uses the Bernoulli's principle which says that there is a relationship between the pressure of the fluid and the velocity of the fluid. When the velocity increases, the pressure decreases and vice versa.

Particulates: Air-borne solids, such as dust.

PCDDs/PCDFs: A generic term to indicate all dioxins and furans as a group; polychlorinated dibenzo-dioxins (PCDDs) and polychlorinated dibenzo-furans (PCDFs).

pg/g: Picograms per gram; equivalent to parts per trillion (ppt).

pH: The symbol for the logarithm of the reciprocal of hydrogen atom concentration in gram atoms per liter, used to describe the acidity or alkalinity of a chemical solution on a scale of 0 (more acidic) to 14 (more alkaline).

Polychlorinated: Refers to having more than one chloride (Cl^-) atom in the structure of the compound. Polychlorinated compounds are often quite toxic to human health.

Polyurethane Foam (PUF): Polyurethane is any polymer consisting of a chain of organic units joined by urethane (carbamate) links. Polyurethanes are widely used in high resiliency flexible foam seating known as polyurethane foam (PUF). PUF are used as a sorbent sample tubes for air sampling.

ppb: Parts per billion; equivalent to micrograms per liter (ug/L).

ppm: Parts per million; equivalent to milligrams per kilogram (mg/kg) or milligrams per liter (mg/L).

ppq: Parts per quadrillion; equivalent to picograms per liter (pg/L).

ppt: Parts per trillion; equivalent to picograms per gram (pg/g) or nanograms per kilogram (ng/kg).

Precision: Mechanical or scientific exactness expressing the degree to which further or repeated measurements yield the same or similar results. Can be expressed in terms of number of digits.

PUF Cartridge: Several EPA and ASTM methods require polyurethane foam (PUF) cartridge for monitoring semi-volatiles in stack, ambient, indoor, and workplace atmospheres. PUF cartridges allow sampling rates up to 225L/min with low pressure drop. Small PUF cartridges are useful for the 1-5L/min sampling range.

QA/QC (Quality Assurance and Quality Control): A planned and technical means of monitoring and measuring the correctness of a program. Duplicate samples, for instance, help measure the difference in chemical concentration that can occur within the same sample.

Quality Assurance Sample: Part of the QA/QC program, these samples include duplicates, blanks, and MS/MSDs and are used to help ensure the overall technical quality of the program and data.

Regulatory Guidelines: A set of rules created by a government agency, such as the U.S. Environmental Protection Agency.

Regional Screening Levels (RSLs): for Chemical Contaminants at Superfund Sites RSLs are conservative, risk-based screening levels developed by U.S. EPA to evaluate potential of exposure to air contaminants via inhalation associated with Superfund remedial activities. The RSLs for ambient air are based on long-term residential exposure and consider both non-cancer and cancer effects (if applicable). (U.S. EPA 2009; http://www.epa.gov/reg3hwmd/risk/human/index.htm).

Screening Levels: A generic term used to categorize chemical concentrations that indicate a particular level that may or may not be a regulation, such as the FDA Action Level, or U.S. EPA water quality criteria.

Spiked: The introduction of a known amount of a chemical into a medium. Spiking samples is used to help laboratories calibrate instruments and equipment.

Tetra: Having four. Such as tetra-chlorinated compounds that have four chloride atoms.

Toxic Equivalency (TEQ): The sum of the concentrations times their respective TEF. The TEQ is the concentrations that presents the total toxicity of a group of compounds. Specific to dioxin-like compounds.

Toxic Equivalency Factors (TEF): A set of multipliers used with a number of chemicals with different levels of, but a similar mode of toxicity. TEFs weight the toxicity of a chemical against the most toxic of the group of chemicals. For instance, if compound A is the most toxic and compound B is 1/100 as toxic, then the TEF for B would be 0.01.

Toxic: Hazardous; poisonous.

Trend Analysis: The mathematical study of the nature of general courses or prevailing tendencies, such as the increase or decrease in chemical concentration over time.

Trip Blank: A trip blank is a sample of analyte free media collected in the same type of container that is required for the analytical test, taken from the laboratory to the sampling site and returned to the laboratory unopened.

Venturi Flow Device: A venturi flow meter is a device in which fluid is accelerated through a converging cone of angle 15-20° and the pressure difference between the upstream side of the cone and the throat is measured and provides a signal for the rate of flow.

Windroses: Wind roses are information packed plots providing frequencies of wind direction and wind speed. A wind rose can indicate the dominant wind directions and the direction of strongest wind speeds.

X-ray Fluorescence (XRF): X-ray fluorescence (XRF) spectrometer is an x-ray instrument used for routine, relatively non-destructive chemical analyses of rocks, minerals, sediments and fluids. It works on wavelength-dispersive spectroscopic principles that are similar to an electron microprobe (EPMA). The relative ease and low cost of sample preparation, and the stability and ease of use of x-ray spectrometers make this one of the most widely used methods for analysis of major and trace elements in rocks, minerals, and sediment.

Appendix A

Field Notes, Chain of Custody Documentation and Laboratory Data